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EOCENE MOLLUSCA FROM THE SUBATHU GROUP (LUTETIAN) SIMLA HILLS STATE, INDIA

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In 1922, during the course of an American Museum Expedition whose principal object was the collection of vertebrate remains from the Siwalik Series, Dr. Barnum Brown made a small collection of mollusca from the Eocene deposits in the Simla Hills State. These are from deposits referred to the Subathu Group and are here described.

In 1853–1854, d'Archiac and Haime described the first fossils from the Subathu region in their 'Description des Animaux Fossiles du Groupe Nummulitique de l'Inde.' They list 49 species, 32 of them being described as new. The fauna is poorly preserved, and the majority of the identifications are based on internal casts, with the result that many are wholly unidentifiable as described and figured in their report. Medlicott (1865, p. 100) lists 17 species of mollusca from his Subathu Group, the identifications being with species described by d'Archiac and Haime or, in 7 cases, to genus only.

These are the only previous reports on the fauna from this area. Cox (1931*a*) in his report on the molluscan fauna of the Laki and basal Khirthar groups excludes this fauna from his discussion, though referring to these species described from Subathu which have been found in the Laki Collections.

SUBATHU GROUP

The Subathu Group was defined and described by Medlicott (1865, pp. 74–100) who states (p. 74) that the group "exhibits a very considerable diversity of mineral characters" and gives the following general succession:

3. Fine grained, massive sandstones
2. Gritty, lumpy, bright red clays
1. Yellowish-brown silt

Throughout his discussion of these beds, however, he refers to the middle group as being "red and gray, marly nummulitic clays" (pp. 77–78,

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etc.). The strata are much contorted, folded and faulted, but the thickness of the group "can scarcely be less than 3,000 feet" (p. 74).

LOCALITIES

Two localities are represented in the collection:

1.—Twenty-one miles northwest of Simla and five miles northwest of Arki. The matrix is a calcareous, yellowish-brown silt, and is referable to the lower beds of the group as defined above.

2.—Twenty-two miles northwest of Simla and six miles northwest of Arki. The matrix is a gray, lumpy clay, somewhat mottled reddish brown and is broken and contorted. The strata at this locality are reported to be vertical.

This clay contains a fauna which is similar to that reported by d'Archiac and Haime from the "Marnes noires" and the middle zone of Medlicott's section is probably to be regarded as that which was referred to by d'Archiac and Haime, despite his assertion (p. 74, footnote) that "I fail to recognize in the Subathu section the rocks spoken of by d'Archiac as Marnes noires and psammite."

AGE OF THE SUBATHU FAUNA

Cox, (1931*a*), refers the fauna at Subathu to the Lutetian stage, but does not state his reasons for so doing. The material in the present collection does not offer any definite evidence as to the exact correlation of the strata, though there are no forms inconsistent with a Lutetian assignment. Most significant is the presence of the genus *Euphenax*. *E. jamaicensis* (Trechmann), the only species previously described, occurs in the Lutetian of Somaliland and Jamaica, and in the Lower Khirthar, (basal?) Lutetian of India. The genus is represented in our collection by a new species, *E. coxi*. *Involuta daviesi* Cox is also a Lower Khirthar species, but it is represented in our collection by a fragment too poorly preserved to permit certain identification.

DESCRIPTION OF THE SPECIES

A.—Fossils from the locality twenty-one miles northwest of Simla and five miles northwest of Arki, lower zone of the Subathu Group.

EUPHENAX Cox, 1931

GENOTYPE (by original designation).—*Pseudoheligmus* (*?*) *jamaicensis* Trechmann. Eocene.

Euphenax coxi, new species

Figure 1

HOLOTYPE.—A.M.N.H. No. 24911; length, 30 mm.; height, 37.1 mm.; diameter (both valves), 10 mm.

Shell of moderate size, somewhat *Pteria*-form in outline with a well-marked posterior and a small anterior auriculation. The anterior and posterior margins are slightly convex to almost parallel, the ventral broadly and regularly rounded. Shell very thin, lamellar, the lamellae rising to form a series of radial riblets over the surface, except near the umbo where they have been worn away to expose a series of concentric laminae. The hinge consists of a typical vulsellid ligamental pit and a groove along the dorsal margin to the end of the posterior auriculation. A feebly impressed elongate muscle scar parallels the posterior margin of the shell extending approximately two-thirds the height of the shell from immediately below the posterior ear.

Consideration of the great range of variation shown by Cox (1931, pp. 177–183, Pl. xx, Pl. xxi, figs. 1*a*, *b*, 2) to exist in *E. jamaicensis* makes one hesitate to describe a new species of this genus from strata of contemporaneous age. But the differences which separate the present form from the genotype seem to be well beyond the limits of variation indicated for *E. jamaicensis*, and are of specific import. The valves are much less inflated and the shell is equivalved. The presence of a marked posterior dorsal wing appears to be distinctive, though it is not at all times as strongly developed as on the holotype. In the structure of the shell the lamellae do not rise as thin bands equally thick throughout, as indicated by text figure 1, p. 181 of Cox's study, but instead are relatively thick when they debouch from the shell surface and tend to progressively thin toward their outer limits. No cellular structure formed by their fusion above the surface of the shell has been observed. Near the umbo where these outer laminae have been eroded away, the laminated surface of the inner layer of the shell shows no evidence of any development of an ornamentation of fine radial grooves. Internally, the groove extending along the dorsal margin of the valve is distinctive. An apparently similar structure, which seems to be morphologically distinct, is shown by Cox (Pl. i, fig. 1*a*) extending along the sides of the valve. This, however, is formed between the elongate, radially arranged cells of the outer layer, and the more compact inner layer of the shell. No internal hollow chambers, as indicated by Cox (text figure 2, p. 181), can be observed.

As in *E. jamaicensis* no anterior muscle scar has been noted, and, if as seems most logical, *Euphenax* is a member of the *Vulsellidae*, none is to be expected. However, the extreme posterior dorsal position of the observed scar is a noteworthy and remarkable feature of a monomyarian genus.

OSTREA LINNÉ, 1758

GENOTYPE (by subsequent designation, Children, 1823).—*Ostrea edulis* Linné. Recent.

SUBGENUS **LIOSTREA** DOUVILLÉ, 1904

GENOTYPE (by original designation).—*Liostrea lamellosa* (error pro *O. sublamellosa* Dunker; see Bull. Geol. Soc. Fr., (4) IV, p. 546).

Ostrea (Liostrea) cf. rouaulti Mallada

Ostrea (*Liostrea*) cf. *rouaulti* Mallada, Cox, 1931*a*, p. 63, Pl. III, figs. 5, 6, 7, 8.

The variations in shape indicated by the specimens figured by Cox can be closely matched by material in our collections.

CARDITA BRUGUIÈRE, 1792

GENOTYPE (by subsequent designation, Children, 1823).—*Cardita sulcata* Bruguière = *Chama antiquata* Linné. Recent.

Cardita sp. indet.

Two casts of a small, inflated *Cardita* bearing about 20 ribs separated by interspaces of approximately equal width occur in the collections. The ribs appear to have been rounded or flat-topped, and the casts show no evidence of any tripartite characters. The forms resemble *C. subcomplanata* d'Archiac and Haime (1854, p. 252, Pl. XXI, figs. 10, 10*a*), but appear to be more inflated than that species.

A crushed and fragmentary specimen of a *Cardita* bearing about 17 ribs, markedly tripartite on the posterior and median portions of the valve, is probably to be referred to *C. mutabilis* d'Archiac and Haime (1854, p. 256, Pl. XXI, figs. 3–6). (See: Cox, 1931*a*, p. 69, Pl. III, figs. 14, 15, 16.) The specimen is, however, too incompletely preserved to permit definite specific determination.

DISCORS DESHAYES, 1858

GENOTYPE (by tautonomy).—*Cardium discors* Lamarck. Eocene.

This is the *Cardium parisiense* d'Orb. of Deshayes (1858, II, p. 569). The only other species included was *C. subdiscors* d'Orb, so that *C. lyratum* Sowerby, cited by Fischer (1887, p. 1038) is not available.

Discors simlaensis, new species

Figure 3

HOLOTYPE.—A.M.N.H. No. 24914; length, 27 mm.; height, 31 mm.; diameter (both valves), 19.5 mm.

DESCRIPTION.—Shell of moderate size, inflated, sub-equilateral; umbos moderately small, central; anterior and ventral margins regularly and broadly rounded, posterior ventral margin slightly broken, but sharply rounded, posterior margin broadly convex, dorsal margin short and nearly straight; surface ornamentation characteristic of the genus, the posterior third of the shell surface marked by 23

radial ribs, the anterior 15 of these being moderately well developed and separated by interspaces approximately one-half the width of the ribs; the posterior ribs are finer, the interspaces linear; the anterior portion of the valve is ornamented by distant, low, lamellar riblets which are slightly oblique to concentric and tend to be obsolete on the central area of the shell; hinge not observed.

This may be the form referred by Cox (1931*a*, p. 84) to *Cardium bunburyi* d'Archiac and Haime (1854, p. 260, Pl. XXXIII, figs. 7, 7*a*), but, as illustrated, that species is much more inequilateral and differs markedly in outline from our specimen.

PANOPEA MENARD, 1807

GENOTYPE (by subsequent designation, Schmidt, 1818).—*Mya glycimeris* Gmelin. Recent.

Panopea cf. **intermedia** (J. Sowerby)

Figure 2

Panopea cf. *intermedia* (J. Sowerby), Cox, 1931*a*, p. 85, Pl. IV, figs. 13*a*, *b*.

HYPOTYPE.—A.M.N.H. No. 24913; length (incomplete), 33 mm.; height, 19.6 mm.; diameter (both valves), 18.2 mm.

One specimen, slightly smaller, but otherwise identical with that figured by Cox under the above designation, occurs in the collection. It is more complete posteriorly, and the corrugated sculpturing is particularly well developed in this region.

The species described by d'Archiac and Haime (1854, p. 232, Pl. XVI, figs. 2, 2*a*), as *Panopaea ? subelongata* appears to be a venerid, possibly referable to *Macrocallista*.

GOSAVIA STOLICZKA, 1865

GENOTYPE (by original designation).—*Voluta squamosa* Zekeli. Cretaceous, Europe.

Gosavia humberti (d'Archiac and Haime)

Figure 7

Voluta humberti D'ARCHIAC AND HAIME, 1854, p. 327, Pl. XXXIV, fig. 9.
Gosavia humberti d'Archiac and Haime, STOLICZKA, 1867, p. 73.
Gosavia humberti (d'Archiac and Haime) Cox, 1931*a*, pp. 57–8, Pl. I, fig. 18.
HYPOTYPE.—A.M.N.H. No. 24909; length, 61.4 mm.; diameter, 39 mm.

Two casts referable to this species are in the collections. In attempting to determine the number of folds on the inner lip (probably five) a small area of shell surface was exposed. This bears distant, low, rounded spiral threads separated by smooth interspaces approximately four times the width of the rib.

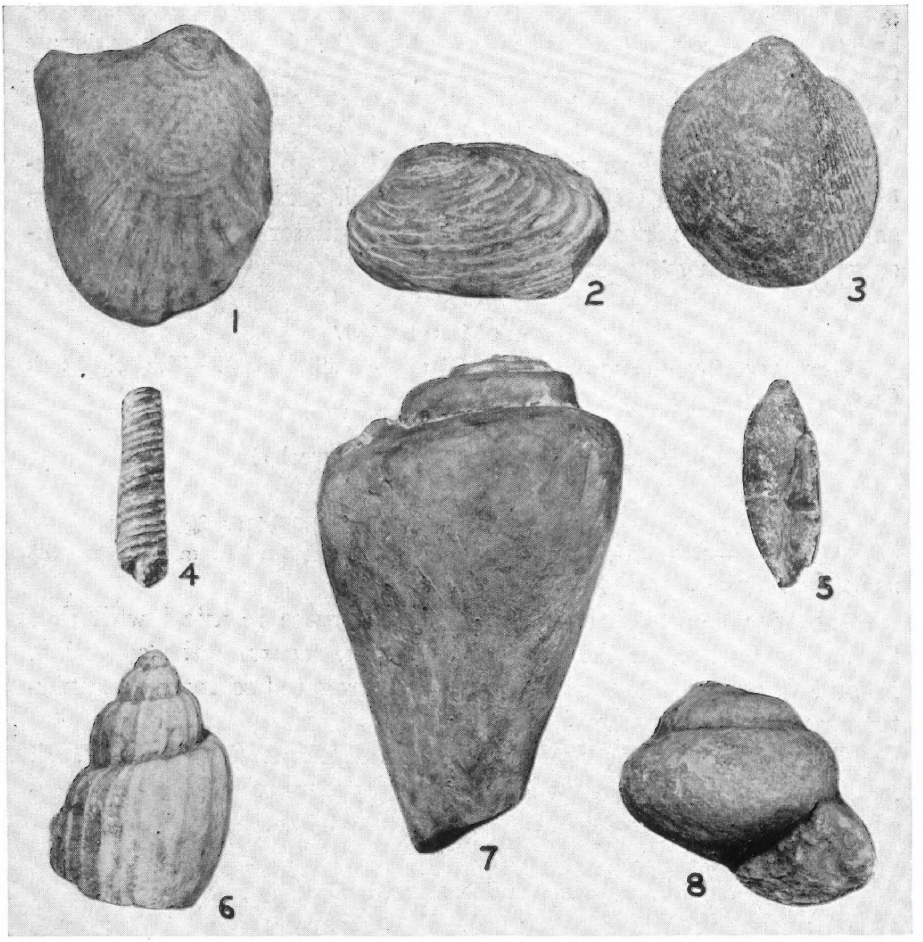

Fig. 1. *Euphenax coxi*, n. sp. × 1. Holotype, A.M.N.H. No. 24911.
Fig. 2. *Panopea* cf. *intermedia* (J. Sowerby). × 1. Hypotype, A.M.N.H. No. 24913.
Fig. 3. *Discors simlaensis*, n. sp. × 1. Holotype, A.M.N.H. No. 24914.
Fig. 4. *Seila stracheyi* (d'Archiac and Haime). × 2. Hypotype, A.M.N.H. No. 24916.
Fig. 5. *Terebellum* sp. × 1. Figured Specimen, A.M.N.H. No. 24915.
Fig. 6. *"Lyria" browni*, n. sp. × 1. Holotype, A.M.N.H. No. 24910.
Fig. 7. *Gosavia humberti* (d'Archiac and Haime). × 1. Hypotype, A.M.N.H. No. 24909.
Fig. 8. *"Turbo"* (?), n. sp. × 1. Figured Specimen, A.M.N.H. No. 24912.

? **Gosavia multidentata** (d'Archiac and Haime)

Voluta multidentata d'Archiac and Haime, 1854, p. 326, Pl. xxxii, figs. 1, 1*a*.
Gosavia multi-dentata d'Archiac and Haime, Stoliczka, 1867, p. 73.
Gosavia multidentata (d'Archiac and Haime) Cox, 1931*a*, p. 58.

One specimen apparently representing the genus *Gosavia* and distinguished from *G. humberti* in possessing convex rather than flat sides is questionably referred to *G. multidentata*. The spire is, however, relatively higher than shown in the figures of d'Archiac and Haime (*loc. cit.*). A posterior labial sinus is present. The number of folds on the inner lip cannot be determined.

Conus Linné, 1758 (*s. lat.*)

Conus sp.

A crushed and fragmentary specimen in the collections seems to be similar to the form figured by Cox (1931*a*, Pl. i, fig. 11) as *Conus* sp. indet.

Involuta Cox, 1931

Genotype (by original designation).—*Involuta daviesi* Cox, Eocene, Lower Kirthar group, India.

Cf. **Involuta daviesi** Cox

Involuta daviesi Cox, 1931*a*, pp. 58–59, Pl. ii, figs. 2*a*, *b*, *c* (?), 4.

A fragment of a large individual bearing twelve or thirteen plications on the inner lip of the aperture is tentatively referred to this species. The shell was relatively very thin.

Lyria Gray, 1847

Genotype (by original designation).—*Voluta nucleus* Lamarck. Recent.

"Lyria" browni, new species

Figure 6

Holotype.—A.M.N.H. No. 24910; length (incomplete), 33 mm.; diameter, 22.6 mm.

Description.—The holotype, and only specimen, is incomplete, lacking the nuclear whorls, the anterior portion of the body whorl and the aperture. The shell is of medium size, moderately high spired, of five post-nuclear whorls, which are markedly convex in outline and bear a well-developed sutural shoulder. The suture is impressed. The whorls are ornamented by axial ribs, which are slightly protractive and sinuous, being somewhat continuous down the spire, 14 on the penultimate and ante-penultimate whorls, and 19 on the body whorl.

This species appears to be very similar to that figured by d'Archiac and Haime (1854, p. 323, Pl. xxxi, figs. 19, 20) as "*Voluta jugosa* J. de C. Sowerby ? var. *a*." Sowerby (1840, p. 329, Pl. xxvi, fig. 25), re-

ferred his species to the Miocene, and Vredenburg (1923, pp. 264, 266) states that it occurs in the Gaj formation (Lower Miocene) of Kachh and Sind. Fedden (1880, p. 208) indicates that the "*Voluta jugosa* C. Sowerby, et var." ranges through the Ranikot, Khirthar, and Nari Groups in Sind. Cox (1931*a*) does not include the specimen in his study of the material from the Laki Group, which d'Archiac and Haime described.

"*L.*" *browni* appears to belong to the group of large species of *Lyria* similar to *L. maga* Edwards of the Lutetian-Bartonian of Europe and *L. andersoni* Waring of the Domengine stage of California (see: Clark and Vokes, 1936, Pl. 1, figs. 17, 18), but differs from these species in possessing a larger number of axial ribs. The generic identification of this species is based upon the above resemblance and must be considered as provisional only.

"Cassidaria," new species cf. **desori** d'Archiac and Haime

Cf. *Cassidaria desori* d'Archiac and Haime, 1854, p. 317, Pl. xxxi, figs. 2, 2*a*.

A worn fragmentary specimen in the collection somewhat resembles this species, which Fedden (1880, p. 208) reports as from the Ranikot series. Fedden's work contains numerous mistakes (see Cox, 1931*a*, p. 25, footnote), and none of the subsequent studies of the Ranikot gastropod faunas list this species. Our specimen differs in possessing a slightly less globose body whorl, which has a more sloping shoulder. The ornamentation, which is preserved on the shoulder of the whorl, shows three primary and four intercalated secondary spiral riblets in that area. The surface of the shell over the rest of the whorl is too worn to permit accurate study of the sculpturing.

If the figure of d'Archiac and Haime is to be trusted, the relative absence of callus on the inner lip and columella suggests that their species is probably to be referred to some genus of the *Cassidae* other than *Cassidaria* Lamarck, 1812 (=*Galeodea* Link, 1807). Our specimen shows a slight callus wash near the siphonal fasciole and suggests a possible reference to *Casmaria* H. and A. Adams, 1857.

Campanile Bayle, in Fischer, 1884

Genotype (by subsequent designation, Cossmann, 1889, 'Catalogue Illustre,' Fasc. 4, p. 29).—*Cerithium giganteum* Lamarck. Eocene.

Campanile sp.

One worn fragment, representing approximately two and one-half whorls of a large species of *Campanile*, is present in the collections. The whorls are narrow with a diameter about three times their height, slightly concave in outline, and possess a moderately prominent shoulder immediately below the suture. This shoulder appears to have been ornamented with a strong spiral rib, which may, or may not, have been tuberculate. Immediately below are seven spirals, the first, third, and fifth of which are slightly less than twice the width of the intercalated spirals. The columella was plicated and bore at least two folds.

The specimen has been too greatly crushed to permit accurate determinations of the apical angle, but it appears to have been approximately 23 degrees.

This species appears to possess a larger number of spiral ribs, which are finer and more closely approximate than those of any described species from the Asiatic Eocene deposits. In general, the apical angle seems to be smaller than most described forms, and the spire may have been relatively higher. This may be only an apparent distinction, however, since many species of this genus show a tendency toward an increase in the relative widths of the whorls in the later stages of growth, with a consequently greater apical angle.

AMPULLELLA Cox, 1931

GENOTYPE (by original designation).—*Ampullaria depressa* Lamarck. Eocene.

Ampullella nuttalli Cox

Ampullella nuttalli Cox, 1931*a*, p. 41, Pl. 1, figs. 14*a*, *b*.

One specimen, of approximately five whorls, and smaller in size than the holotype, occurs in the collections. The shouldered whorls and the strong siphonal fasciole are distinctive.

"Turbo" (?), new species

Figure 8

FIGURED SPECIMEN.—A.M.N.H. No. 24912; length (incomplete), 27.5 mm.; diameter, 34 mm.

One cast, of three whorls, lacking the apical portion of the shell, is totally unlike any form reported from the Asiatic Eocene, insofar as I am able to discover. The spire is elevated, the whorls broadly rounded and the suture appears to have been linear. The shell was evidently thin, and was imperforate. The aperture is subtrigonal in section, but the outer lip is broken away and growth lines are not visible, so that it is impossible to determine if it was angulate to the periphery.

The systematic position of this form is wholly conjectural. It is provisionally referred to the genus *Turbo* (*s. lat.*) because of the relatively high spire and the imperforate base. The thin shell, however, does not tend to confirm this assignment. It may prove to be related to *Turbo d'archiardii* Vinassa de Regny (1895, p. 36, Pl. II, fig. 7) from the Alpine Eocene, referred by Cossmann (1918, XI, p. 115, Pl. III, fig. 12, and Pl. X, fig. 45) to the genus *Sarmatius* Gray, 1840, emended (correctly *Samarticus* Gray, genotype *Turbo samarticus* Linné, Recent), though the aperture in that species is rounded rather than trigonal.

B.—Species from the locality twenty-two miles northwest of Simla and six miles northwest of Arki, middle zone of the Subathu Group.

Cardita mutabilis d'Archiac and Haime

Cardita mutabilis d'Archiac and Haime, 1854, p. 256, Pl. XXI, figs. 3, 6.—Cox, 1931*a*, pp. 69–70, Pl. III, figs. 14, 15, 16.

Cardita depressa d'Archiac and Haime, 1854, p. 255, Pl. XXI, figs. 1, 2; not *Cardita depressa* Lamarck, 1819, Hist. Nat. Anim. sans Vert., 1re Edit., VI, p. 23; nor *C. depressa* Münster, 1839.

A number of specimens representing this species are in the collection, and appear to confirm the conclusion of Cox (1931*a*, p. 70) that the two species described by d'Archiac and Haime from "Subathoo" "represent one and the same variable species." The elongate, nearly equilateral type of the original *C. mutabilis* is the more abundant form in our collections, and is probably to be considered the normal expression of the species.

Cardita, new species (?)

Cardita subcomplanata var. *a.* d'Archiac and Haime, 1854, p. 252, Pl. XXI, figs. 11, *a*, *b* (not figs. 10, *a*).

Four specimens in the collection appear to be referable to the form described by d'Archiac and Haime from "Subathoo" as *Cardita subcomplanata* var. *a.* They appear to bear fewer radial ribs, and to be more equilateral than that species, though one specimen attains a comparable size.

Terebellum (Bolten) Roeding, 1798

Genotype (by tautonomy).—*Bulla terebellum* Linné. Recent.

Terebellum sp.

Figure 5

Terebellum fusiforme Lamarck ?, d'Archiac and Haime, 1854, p. 335, Pl. XXXII, fig. 23.

FIGURED SPECIMEN.—A.M.N.H. No. 24915; length, 26 mm.; diameter, 9.6 mm.

A single specimen of this genus is noted. It agrees with the form figured by d'Archiac and Haime as *T. fusiforme* Lam. ?, but differs from the Paris Basin species in having a more convex outline, and in being relatively wider in proportion to the length of the shell. The spire is higher and the whorls appear to have been slightly shouldered.

SEILA A. ADAMS, 1861

GENOTYPE (by subsequent designation, Fischer, 1884).—*Cerithiopsis dextroversa* (Adams and Reeve) (= *Triphoria dextroversa* Adams and Reeve). Recent.

Seila stracheyi (d'Archiac and Haime)

Figure 4

Cerithium stracheyi D'ARCHIAC AND HAIME, 1854, p. 304, Pl. XXIX, figs. 9, 9*a*. MEDLICOTT, 1864, p. 100.

Seila stracheyi d'Archiac, COSSMANN, 1906, Ess. Paleoconch. Comp., VII, p. 154.

HYPOTYPE.—A.M.N.H. No. 24916; length (incomplete), 12.8 mm.; diameter, 3.7 mm.

This is the most abundantly represented species in the collection. The three primary spiral ribs appear to be present on all post-nuclear whorls. The earliest of these seem to have the anterior rib more strongly developed than the others, and the whorls tend to be slightly keeled.

The outline of the whorls on our specimens is somewhat more convex than indicated in the original figure, and the species superficially resembles, and might be mistaken for, *Turritella hollandi* Cossmann and Pissarro (1909, p. 60, Pl. v, figs. 17–19) from the Ranikot series. That species attains a larger size, and has a somewhat more deeply channeled suture.

The nucleus is not present on any of the specimens, and the reference to the genus *Seila* is based upon its resemblance to the species from the Paris Basin Eocene referred to that genus by Cossmann (*loc. cit.*). He, however, cites *Cerithium trilineatum* Phil. as the type of the genus *Seila*. This species is not available, for Adams states (Ann. and Mag. Nat. Hist., (3) VII, p. 131) that the "section" was "founded on *Triphoris dextroversus* Adams and Reeve and a new species" [*Cerithiopsis* (*Seila*) *cingulata* A. Adams].

Cerithiidae indet.

A fragment, 2.3 mm. in length, consisting of two whorls of a small species of Cerithiidae, is worthy of mention because of the characteristic nature of the sculpturing. Immediately anterior to the suture is a row of strong, slightly elongate nodes born on a weak, low spiral rib. Below

this, and separated by an interspace approximately as wide as the nodes, is another low spiral bearing strong rounded nodes, separated from each other by spaces of equal width. These nodes are slightly offset to the right in relation to the upper row. The interspace between the two rows is marked by a single simple, spiral riblet. The area of the shell from this second row of nodes to the next suture line is divided into equal parts by three primary spirals, the upper two of which are strongly granulate, but not definitely noded. The posterior spiral is simple.

Cf. **Cepatia cepacaea** Lamarck

A single, very immature specimen of a naticoid gastropod resembles similarly immature specimens of the above species from the Eocene of the Paris Basin.

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